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# On the convergence of an explicit difference scheme for evolution variational inequalities with nonlocal space operator

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## Abstract

© 2017, Pleiades Publishing, Ltd.A nonlinear parabolic variational inequality with nonlocal space operator monotone with respect to gradient is considered. An explicit difference scheme with respect to the space operator and an implicit difference scheme with respect to the penalty operator are constructed by using the penalty method and the method of integral identities. Stability conditions for the constructed difference scheme are obtained. A convergence theorem with minimal assumptions on the smoothness of the initial data is proved.

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## Keywords

convergence, explicit difference scheme with penalty operator, nonlocal operator, operator monotone with respect to gradient, stability, variational inequality

## References

[1] J.-L. Lions, SomeMethods of Solving Non-Linear Boundary Value Problems (Dunod-Gauthier-Villars, Paris, 1969; Mir, Moscow, 1972).

[2] K. Greger, K. Zaharias, and H. Gaevsky, Nonlinear Operator Equations and Operator Differential Equations (Mir, Moscow, 1978).

[3] M. Chipot and L. Molinet, “Asymptotic behavior of some nonlocal diffusion problems,” Appl. Anal. 80, 279–315 (2001).

[4] M. Chipot and B. Lovat, “Existence and uniqueness results for a class of nonlocal elliptic and parabolic problems,” Dyn. Contin. Discrete Impuls. Syst. Ser. A:Math. Anal. 8, 35–51 (2001).

[5] L. Simon, “On quasilinear parabolic functional differential equation with discontinuous terms,” Ann. Univ. Shi. Budapest 47, 211–229 (2004).

[6] O. V. Glazyrina and M. F. Pavlova, “On the solvability of an evolution variational inequality with a nonlocal space operator,” Differ. Equations 50, 873–887 (2014).

[7] O. V. Glazyrina and M. F. Pavlova, “A theorem for solution uniqueness of evolutionary variational inequality with nonlocal spatial operator,” in Proceedings of the 10th International Conference on Grid Methods for Boundary Value Problems and Applications (Kazan. Fed. Univ., Kazan, 2014), pp. 205–208.

[8] M. F. Pavlova, “On the solvability of nonlocal nonstationary problems with double degeneration,” Differ. Equations 47, 1161–1175 (2011).

[9] O. V. Glazyrina and M. F. Pavlova, “The unique solvability of a certain nonlocal nonlinear problem with a spatial operator strongly monotone with respect to the gradient,” Russ. Math. (Iz. VUZ) 3, 83–86 (2012).

[10] O. V. Glazyrina and M. F. Pavlova, “Study of the convergence of the explicit difference scheme for parabolic equation with nonlinear nonlocal space operator,” Uch. Zap. Kazan. Univ., Ser. Fiz.-Mat. Nauki 155 (4), 24–39 (2013).

[11] O. V. Glazyrina, M. F. Pavlova, “Study of the convergence of the finite-element method for solving parabolic equations with a nonlinear nonlocal space operator,” Differ. Equations 51, 876–889 (2015).

[12] D. Kinderlehrer and G. Stampacchia, An Introduction to Variational Inequalities and Their Applications (SIAM, Philadelphia, 1987).

[13] H. W. Alt and S. Luckhaus, “Quasilinear elliptic-parabolic differential equations,” Math. Z. 183, 311–341 (1983).